Sandia National Laboratories
Waste Isolation Pilot Plant (WIPP)
Test Plan, TP 00-04

Laboratory Analysis of Samples Collected from the Disturbed Rock Zone

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Rev. 0

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1.0 Approval Page

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2.0 Table of Contents

3.0 Revision History

This is the first issue of this test plan (TP). Changes to TP 00-04, other than those defined as editorial changes per Nuclear Waste Management Program procedure NP 20-1, Rev. 2, "Test Plans," shall be reviewed and approved by the same level of responsibility of persons that performed the original review and approval. All TP 00-04 revisions will follow the same distribution as the original document.

4.0 Definition Of Abbreviations And Acronyms

ASTM	American Society for Testing and Materials
CCA	Compliance Certification Application
EBSD	Electron backscatter diffraction
EPA	Environmental Protection Agency
JCPDS-ICDD	Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data
M&TE	Measuring and Test Equipment
MB	Marker Bed
MOC	Management and Operations Contractor
NIST	National Institute of Standards and Technology
NBS	National Bureau of Standards
NMED	New Mexico Environment Department
NP	Nuclear Waste Management Program Procedure
NWMP	Nuclear Waste Management Program
RWP	Radiological Work Permit
SEM	Scanning Electron Microscope
SNL	Sandia National Laboratories
SP	Nuclear Waste Management Program Activity/Project Specific Procedure
TP	Test Plan
WID	Westinghouse Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
XRD	X-ray Diffraction

5.0 Purpose and Scope

5.1 Scope

The Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, is a mined, underground repository certified by the Environmental Protection Agency (EPA) for the management, storage, and disposal of transuranic (TRU) radioactive wastes generated by US government defense programs and for disposal of TRU-mixed waste by the New Mexico Environment Department (NMED). The waste will be emplaced in panels excavated at a depth of ~650 m in the Permian-age Salado Formation.

The Salado Formation comprises a thick sequence of bedded evaporites, mostly halite, with inter-bedded with anhydrite, clay seams, and interspersed minerals including polyhalite, clay and anhydrite. The repository is excavated in a halite layer, just above one of the thicker anhydrite layers, known as Marker Bed (MB) 139. The stress state is sufficient to promote considerable creep deformation of halite. In addition, fracturing is commonly observed near the excavation surfaces. This study focuses primarily on the zone known as the disturbed rock zone (DRZ). Relative to the intact salt, the DRZ exhibits increased porosity, probably as a result of the microfracturing, and increased permeability as a result of connecting fractures. Over time, the DRZ properties change as salt creep occurs.

TP 99-04, “Disturbed Rock Zone Characterization Test Plan,” provides an overall description of the activities planned for geophysical characterization of the WIPP DRZ. Activities described in TP 99-04 include drilling and coring the DRZ in several locations, emplacement of probes for in situ measurements of moisture, resistivity, density, and other properties. TP 99-04 also references laboratory analysis of core samples, for which this Test Plan has been prepared. This Test Plan describes a suite of research activities for laboratory analysis of core samples, which are being obtained during the conduct of TP 99-04. Laboratory analyses include sample preparation and chemical, structural, and petrographic analysis.

The activities described in this Test Plan will reduce uncertainties about DRZ properties such that long-term performance predictions will improve. This will provide leverage to pursue a number of WIPP waste “pipeline filling” objectives such as expanding the currently restricted acceptable waste envelope.

The scope of TP 00-04 includes investigation of mineral assemblages along fractures that could indicate brine precipitation. In addition, structural assessments of fracture architecture, orientation, aperture, connectivity and other characteristics will be documented from impregnated samples. Some structural petrography will use etch pit techniques on cleavage chips to evaluate the internal structural state of representative halite crystals as a function of drill-hole depth.

Experimental work related to TP 00-04 will primarily be performed at the SNL Carlsbad Operations laboratory facility located in Carlsbad, NM (laboratory work) or at the WIPP facility (sample collection).

5.2 Overall Strategy of the Test Plan

The activities described in this Test Plan will provide information on the development and evolution of fluid flow and geomechanical properties of the DRZ. The laboratory studies defined here will help evaluate the extent of the DRZ, potential for brine transport and release created by

DRZ development, and quantitative descriptions of the structural state associated with the DRZ. In tandem, laboratory moisture content measurements following American Society for Testing and Materials (ASTM) procedures, or their equivalent, will quantify brine content of the cores, provide information on levels of saturation within the DRZ, and allow calibration of *in situ* moisture sensors.

The scope of observational studies is based on many years of results from *in situ* testing, laboratory testing and attendant microscopy. Field tests by Knowles and Howard (1996) indicate both presence and presumed healing of the DRZ associated with seal materials placed in the WIPP test areas. Laboratory studies systematically show that damage can be related to stress invariants (Van Sambeek et al., 1993). Field and laboratory experiments supported by laboratory microscopy studies assist in the evaluation of large-scale results. Characteristics of salt deformation including DRZ development are well documented through microstructural analyses (e.g., Carter and Hansen, 1983, Hansen, 1987, Senseny et al., 1992, Mellegard et al., 1998). This study builds upon techniques used in previous analyses by adding facets of mineralogical studies to establish the nature of deformation in the DRZ.

Microstructural observational work defines fracture characteristics such as aperture and connectivity. Ancillary substructural features, such as dislocation densities and deformation artifacts provide evidence of isochoric strain, which underpins the creep processes embodied in the constitutive model. Observations of fractures from impregnated sections allow determination of anisotropy, which is also fundamentally important to constitutive model implementation. Petrographic and chemical analyses of core samples will ascertain whether or not brine evaporation and precipitation occurs along open fractures. Observation and documentation of precipitation mineralogies assists in understanding possible mechanisms for brine release and transport through the DRZ toward the WIPP waste disposal rooms, drifts, and shafts. The proposed studies will compare and contrast features noted in cores taken near the opening to features observed for cores taken at greater distances from excavated surfaces.

5.3 Intended Use of Data

Information derived from core studies of the DRZ will help quantify the extent of the DRZ and describe features of the DRZ pertaining to a conceptual model for brine transport. These observations will clarify the conceptual model and physical/chemical/hydrological processes. The importance of the DRZ to predicted repository performance has been demonstrated in the performance assessment computations in the Compliance Certification Application and more recently in sensitivity analysis (ASA98). Data derived from core studies support geophysical measurements described in TP 99-04. Data collected within the scope of this test plan will add credibility to *in situ* measurements undertaken in TP 99-04. Collectively these lead to a better model for the development and evolution of DRZ characteristics and more accurate and reasonable parameters for seal system design and analysis and performance assessment calculations.

6.0 Experimental Process Description

6.1 Planning Overall Strategy and Process

6.1.1 Sampling

Coring in the WIPP underground will follow SP 13-2 "Logging and Management of WIPP Core Samples." Sample transfer and collection of sub-samples will be carried out as described in NWMP Procedure SP 13-1 "Chain of Custody," and NP 13-1 "Sample Control." All cores will be kept in air-tight material until time of use. Unused core will be re-sealed and stored as described in SP 13-2.

6.1.2 Sample Preparation and Laboratory Analysis

Sample preparation techniques will vary depending upon type of analysis to be performed, and new techniques will be developed as needed. Types of analysis that may be carried out on core samples from the DRZ include:

- Moisture content determination.
- Chemical and mineralogical analyses.
- Fracture analysis and
- Etched cleavage chips.

6.1.2.1 Moisture Content:

This procedure will determine the mass of water removed by drying to a constant mass following ASTM D 2216-98, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass," or an equivalent procedure. Core samples will be unsealed removed from their sealed plastic bags and immediately weighed. They will then be dried in a Fisher Scientific Isotemp Oven (Model 725F) at 110 +/_ 5ºC. Time required to obtain constant mass will very depending on material, specimen size, and other factors. Drying is continued until the mass after two successive periods (greater than ½ hour) of drying indicate a less than 0.1 percent change.

6.1.2.2 Chemical and mineralogical analysis:

Initial mineralogical samples will be extracted from cores in the vicinity of weeps. This selection is predicated on the assumption the weep indicates that brine flow has occurred. If brine evaporated in the DRZ there should be some deposition of secondary salts on DRZ fracture surfaces. Unlike halite, some of these salts (carnallite and bischoffite in particular) are anisotropic and should be readily detected by petrographic studies. Because Salado brine is much richer in K, Mg, and sulfate than Salado rock salt, evaporation of this brines should leave a distinctive elemental signature on fracture/flow surfaces. Both petrographic and bulk chemical analyses of the core will be conducted. Petrographic studies will focus on determining if significant precipitation of salts has occurred in DRZ fractures. A technical procedure for visual and petrographic description, photography, and subsampling of clay-size materials from core samples will be developed using SNL TOP 554 (for clay fractions) as a template, if appropriate.

Types of chemical analysis which may be carried out include:

Determination of carbonate content. It is postulated that precipitate residue may be enriched in carbonate. To investigate the possibility of DRZ samples containing precipitated carbonate minerals due to brine evaporation, core samples may be crushed and analyzed for carbonate content using a UIC, Inc. Model CM-150 Carbon Analyzer equipped with acidification and furnace modules.

Analysis of soluble components. If K, Mg-rich brine precipitates are observed on fracture surfaces, bulk core samples may be crushed and digested in deionized water. After filtering to remove clays and other insolubles from the dissolved sample, it will be analyzed for major elements using a Perkin-Elmer Model 3300DV Inductively-Coupled Plasma Optical Emission Spectrometer (ICP).

Bulk analysis. If a chemical bulk analysis is required, soluble samples will be analyzed as above, but the insoluble residue that is retained will be weighed, digested, and analyzed using the ICP. The results of the two analyses will then be added together to determine the bulk composition of the sample.

In order to identify precipitated brine minerals on DRZ fracture surfaces, cut and polished samples will be prepared and will be examined for brine precipitates using an Olympus BX-60 Petrographic Microscope and/or JEOL JSM5900LV scanning electron microscope (SEM). The SEM is equipped with an energy-dispersive X-ray analysis system (EDS) for qualitative compositional analysis of mineral grains and for multi-element mapping, and with an electron backscatter diffraction (EBSD) detector for measuring the crystal structure of individual mineral grains. The structural information can be cross-referenced to the Joint Committee on Powder Diffraction Standards–International Centre for Diffraction Data (JCPDS-ICDD) database for phase identification purposes. Variations in sample mineralogy and texture will be described and digitally photographed, and modal mineral compositions and distributions will be quantified.

Precipitated brine minerals, if relatively abundant, may also be identified by X-ray Diffraction (XRD) analysis using a Bruker AXS D8 Advance X-ray Spectrometer. Samples will be ground or scraped from fracture surfaces, crushed, and analyzed as packed-powder mounts with the XRD. Small-volume samples may be sealed in a capillary tube and analyzed using a capillary stage.

6.1.2.3 Structural analysis:

Oriented subsamples will be collected from DRZ cores and examined to determine fracture patterns within the zone. These may be vacuum-impregnated with colored or fluorescent epoxy, cut and polished with rock saws and polishing equipment (a non-aqueous lubricant will be used during cutting and polishing to avoid mineral dissolution). Existing damage in the form of microcracks will be characterized using standard optical microscopy, laser-confocal microscopy (by subcontractor, if desired), and scanning electron microscopy techniques on appropriately prepared subsamples. Thin sections, if required, will be obtained commercially. Analysis of digital images will be carried out manually, or with Image Pro (version 4.0 or higher), a commercial image processing and analysis software package.

The structural state of single salt crystals will be evaluated using standard etching techniques (Carter and Hansen, 1983, and Hansen, 1987). Structural petrology examination uses etched cleavage chips and reflected light microscopy. It is also possible to use a low energy SEM to examine the etched chips at much higher magnification than possible with the optical scope. The etched surface will be studied, photographed and logged into the scientific notebook and photograph library (available on the optical scope and the SEM).

6.2 Data Control

A calibration program will be implemented for the work described in this test plan in accordance with NWMP Procedure NP 12-1, "Control of Measuring and Test Equipment." This M&TE calibration program will meet the requirements in NP 12-1 for: (1) receiving and testing M&TE; (2) technical operating procedures for M&TE; (3) the traceability of our standards to nationally recognized standards such as those from the National Institute of Standards and Technology; (4) maintaining calibration records. In addition, NWMP procedures NP 13-1 and SP 13-1 identify requirements and appropriate forms for documenting and tracking sample possession.

6.2.1 Data Quality Control

Data collection procedures are specific to individual instruments and to the particular application. Initially, data acquisition will implement the Users Manual for that particular instrument. As techniques are developed, a series of activity/project specific procedures (SP) will be developed. Data acquired by a data acquisition system (DAS) integral with a testing apparatus will be attached directly to the Scientific Notebook or compiled in separate loose leaf binders. Identifying labels will allow cross reference to the appropriate Scientific Notebook. If the instrument allows data to be recorded electronically, copies of the data disks will be submitted to the NWMP Records Center. For instruments that do not have direct data printout, the instrument readings will be recorded directly into the scientific notebook. Current versions of the DAS software will be included in the SNL WIPP Baseline Software List, as appropriate.

Quality control of the Scientific Notebooks will be established by procedures described in NP 20-2 *Scientific Notebooks*. Methods for justification, evaluation, approval, and documentation of deviation from test standards and establishment of special prepared test procedures will be documented in the Scientific Notebooks. General procedures, goals and quality assurance controls for TP 00-04 are described below. Procedures including use of replicates, spikes, split samples, control charts, blanks and reagent controls will be determined during the development of experimental techniques.

6.2.2 Data Acquisition Plan

The approach for collecting data varies for each instrument being used. Equipment data printouts will be attached directly to the scientific notebook and logged into the database system attached to the analytical device. Major data sources include photomicrographs. Whereas, large quantities of photomicrographs will undoubtedly be produced, only a select few will be used to demonstrate key features. The Principal Investigator is responsible for retaining all scientific evidence, for example by creating a zip disc for submittal to the NWMP Record Center according to NWMP procedure NP 17-1 "Records." For Quality Assurance purposes, it is important to note that any analysis pertaining to core laboratory studies described here is readily repeatable. For instruments which do not have direct data printout (balances, etc.), the instrument reading will be directly recorded in the scientific notebook. Data acquisition procedures for each instrument will follow the guidelines listed in the specific SP or TOP for that instrument. If no SP exists, or the analysis procedure listed in the SP is modified, the new procedure will be recorded in the scientific notebook.

The numerical data will be transferred from data printouts and scientific notebooks to Microsoft Excel (Office 97 or later version) spreadsheets. Data transfer and reduction shall be performed in such a way to ensure that data transfer is accurate, that no information is lost in the transfer, and that the input is completely recoverable. Data transfer and reduction shall be controlled to permit independent reproducibility by another qualified individual. A copy of each spreadsheet will be taped into the scientific notebook, and a second person will compare the data recorded in the notebook and that on the spreadsheet to verify that no transcription errors have occurred during technical and/or QA review of the notebook. This verification will be documented in the notebook when it is "signed off" by the reviewer.

6.2.3 Data Identification and Use

All calculations performed as part of the activities of TP 00-04 will be documented in a scientific notebook. The notebook will be technically reviewed periodically by a second person, who will note concurrence by co-signing the examined material. If a discrepancy is found, that discrepancy and its resolution will be documented in the notebook. In addition, there will be periodic quality assurance reviews of the notebook to ensure that the requirements of NWMP procedure NP 20-2 *Scientific Notebooks* are addressed.

6.3 Equipment

A variety of measuring and analytical equipment will be used for the work described in this test plan. This equipment includes that listed below, as well as equipment not yet purchased. A complete equipment list, including serial numbers, will be maintained in the scientific notebook. Much of the instrumentation to be used for this project is new, and operating procedures have not yet been developed or written. Scientific notebooks will be used to record all laboratory work activity.

Measuring and analytical equipment to be used for this project include:

6.3.1 Weighing Equipment.

Several balances are present in the facility and may be used for this project. These include a Mettler AT-261 five-decimal place electronic balance, an ANC three-decimal place balance, and top loading balances and scales with maximum ranges of 2 to 30 kilograms. Balance calibration checks will be performed routinely using the following NBS-traceable weight sets, which, in turn, are calibrated by the SNL Calibration Laboratory every 3 years:

- Troemner Calibration weight set, ASTM Class 1, Serial number 22803, 1 mg – 100 g, calibration expires 12/16/02.
- *Troemner Calibration weight*, NBS-Class 1, Serial number 42795, 100 g, calibration expires 11/19/02.
- *Troemner Calibration weight*, NBS-Class 1, Serial number 42797, 100 g, calibration expires 11/19/02.

- *Troemner Calibration weight*, NBS-Class 1, Serial number 42799, 100 g, calibration expires 11/19/01.
- *Troemner Calibration weight*, NBS-Class 1, Serial number 42800, 100 g, calibration expires 11/19/01.
- *Troemner Calibration weight*, ASTM-Class 1, Serial number 47824, 200 g, calibration expires 11/19/02.
- *Troemner Calibration weight*, ASTM-Class 1, Serial number 55335, 1000 g, calibration expires 11/19/02.
- *Troemner Calibration weight*, ASTM-Class 2, Serial number I-12, 10 kg, calibration expires 12/17/02.

Balance accuracy and precision will be checked daily or prior to use (whichever is less frequent), using the calibration weights listed above. Calibration checks will be recorded in the scientific notebook.

6.3.2 Liquid Measuring Equipment

Laboratory Class A glassware (pipettes, volumetric flasks, etc.) will be used at all times. In addition, adjustable pipettes, listed below, will be used for dilutions. The calibration of pipettes will be checked routinely against a calibrated balance, and will be recorded in scientific notebook.

Eppendorf Pipette		Accuracy	Precision
0.5 – 10 µl	at 0.5 µ*l*	± 5 %	≤ 2.8 %
	at 5 µ*l*	±1.5 %	≤ 0.8 %
	at 10 µ*l*	± 1 %	≤ 0.4 %
2.0 – 20 µl	at 2.0 µ*l*	± 5 %	≤ 1.5 %
	at 10 µ*l*	± 1.2 %	≤ 0.6 %
	at 20 µ*l*	± 1.0 %	≤ 0.3 %
10 – 100 µl	at 10 µ*l*	±2.5 %	≤ 0.7 %
	at 50 µ*l*	±0.8 %	≤ 0.3 %
	at 100 µ*l*	± 0.8 %	≤ 0.15 %
50 – 200 µl	at 50 µ*l*	± 1 %	≤ 0.3 %
	at 100 µ*l*	± 0.9 %	≤ 0.3 %
	at 200 µ*l*	± 0.6 %	≤ 0.2 %
100 – 1000 µl	at 100 µ*l*	± 1.6 %	≤ 0.3 %
	at 1000 µ*l*	± 0.6 %	≤ 0.2 %
500 – 5000 µl	at 500 µ*l*	± 2.4 %	≤ 0.6 %
	at 5000 µ*l*	± 0.6 %	≤ 0.15 %
Eppendorf repeater plus: Accuracy and precision vary with tip used and amount dispensed. Tip sizes vary from 100 µl to 50 ml in 8 steps. Accuracy and precision for the largest and smallest are:			
	100µ*l* tip, 2µ*l* dispensed	± 1.6%	≤ 3.0 %
	100µ*l* tip, 20 µ*l* dispensed	± 1.0%	≤ 2.0 %
	50 m*l* tip, 1 m*l* dispensed	± 0.3%	≤ 0.5 %
	50 m*l* tip, 10 m*l* dispensed	± 0.3%	≤ 0.2 %

6.3.3 Other Analytical Equipment

- *pH Meters and Autotitrators* – solution pH may be measured using pH meters and/or autotitrators. A *Mettler Model MA235 pH/Ion Analyzer* and a *Mettler Model DL25 Autotitrator* will be used for this purpose. The range for all pH meters is 0.00 to 14.00. Electrodes will be calibrated before each use or daily (whichever is less frequent) with pH 4, 7, and 10 buffers manufactured by Fisher Scientific with unique lot numbers and expiration dates; traceable to the National Institute of Standards and Technology (NIST). The accuracy of the buffers is ±0.01 pH units; buffer values will be adjusted for laboratory temperatures as per buffer instruction sheets if necessary. Calibration checks will be recorded in the scientific notebook. Measuring pH in concentrated brines is difficult, and a procedure will be developed to calibrate pH meters.
- *Equipment for Chemical Analysis* – Instruments that may be used to chemically characterize crushed or digested samples include; a Perkin Elmer Optima 3300 DV Inductively-Coupled Plasma Optical Emission Spectrometer (ICP); a Cary 300 UV-Visible Spectrophotometer; a UIC, Inc. Carbon Analyzer, consisting of an acidification module, a furnace module, and a CO_2 coulometer. These instruments will be user-calibrated at each use, and calibration results will be documented in the scientific notebook.
- *Equipment for Petrographic, and Textural Characterization* – Several instruments will be used for physical characterization of the DRZ core samples. The mineralogy and texture will be characterized using either an Olympus BX60 Polarizing Microscope or a JEOL JSM 5900LV scanning electron microscope (SEM). Calibration standards will be used to verify instrument magnification when these instruments are used. Bulk sample mineralogy will be determined using a Bruker AXS D-8 Advance X-Ray Diffractometer (XRD). A mineral standard will be run periodically to verify diffraction line positions. Calibration results will be documented in the scientific notebook.

6.4 Location and Personnel

Experimental work related to TP 00-04 will primarily be performed at the SNL Carlsbad Operations laboratory facility located in Carlsbad, NM (laboratory work) or at the WIPP facility (sample collection). Sandia Personnel, including but not limited to Frank Hansen, Charles Bryan and Mary-Alena Martell (6821), and Sandia Contractors Ron Parsons and Wes DeYonge, will carry out the work.

7.0 Nuclear Waste Management Program Procedures (NPs), and NWMP Activity/Project Specific Procedures (SPs)

The following technical work documents cover the work described in this Test Plan.

SOP-C001 – “Standard Operating Procedure for Activities in the SNL/Carlsbad Laboratory Facility.”

SP 13-1 – “Chain of Custody.”

SP-13-2 – "Logging and Management of WIPP Core Samples."

NP 6-1 – "Document Review Process."

NP 13-1 – "Sample Control."

NP 12-1 – "Control Of Measuring And Test Equipment."

NP 20-2 – "Scientific Notebooks."

NP 2-1 – "Qualification and Training."

NP 17-1 – "Records"

In addition, NMWP SPs will be written for use of the ICP, SEM, XRD, Carbon analyzer, UV-Vis spectrophotometer, and assorted balances and scales. Sample preparation procedures, which may vary from sample to sample as work scope evolves, will be detailed in Scientific Notebooks, in accordance with NWMP procedure NP 20-2. The latest versions of these documents are available on the internet at:

http://www.nwmp.sandia.gov/onlinedocuments/

8.0 Records, Reports, and Audits

All records providing evidence of quality, including but not necessarily limited to personnel qualification and training forms, lists of M&TE and software, technical procedures, laboratory notebooks, calibration records, and reports, are QA records, which will be maintained in accordance with NP 17-1, "Records." The format of the enclosed WIPP Records Package will be used to organize QA records. All of these records will be accurate, complete, identifiable, and legible. We will inspect them to ensure they satisfy these requirements prior to submittal to the NWMP records center. We will submit two copies of all QA records to the NWMP Records Center. Submittals will be at the discretion of the PI and will usually be associated with technical publications (an associated Task File, for example), or with the logical conclusion of a segment of work.

We will prepare documents for review and approval in accordance with NP 6-1, "Document Review Process." NP 6-1 requires that the author(s) and reviewer(s): (1) use the DRC Form NP 6-1-1, (see Appendix A in NP 6-1) in some, but not all, cases; (2) resolve all of the comments; (3) return this form with all signatures to the NWMP Records Center.

We will also review documents prepared by others in accordance with NP 6-1.

SNL/WIPP and DOE/CAO representatives will have the right to review the work described in this Test Plan.

9.0 Training

All personnel involved in the experiments described in TP 00-04 will be trained and qualified for their assigned work. This requirement will be implemented through NWMP procedure NP 2-1

"Qualification and Training". Evidence of training to assigned NPs, SPs, TOPs, TP 00-04, ES&H procedures, and any other required training will be documented through a NWMP "*Qualification and Training Form*" (Form NP 2-1-1). Initial and annual Refresher QA training will ensure on-site personnel are trained to the WIPP QA Program.

10.0 Health and Safety

All of the health and safety requirements relevant to the work described in TP 00-04 and the procedures that will be used to satisfy these requirements are described in ES&H standard operating procedures. Sample collection at the WIPP site will be carried out following the site-specific ES&H procedures. SP-C001 (see section 7.1 above) describes the non-radiological hazards associated with these experiments and describes the procedures to deal with those hazards, including all the training requirements for personnel involved in conducting the experiments. In addition, a Radiological Work Permit (RWP) will be written for procedures involving use of the X-Ray Diffractometer. Additional SPs and RWPs may be mandated by SNL ES&H requirements and their issuance will not require revision of this Test Plan.

11.0 Permitting/Licensing

There are no special licenses or permit requirements for the work described in TP 00-04.

12.0 References

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